

WHAT IS CLAIMED IS:

1. A multi-channel fiber optic cable connector for connecting the terminal ends of two multi-channel fiber optic cables having termini of respective ones of multiple optical fibers included within said cables, the connector comprising:

a first housing having a first connector face, a first insert cap tower with and two first insert cap tangs which extend forward of said first connector face, wherein said two first tangs and said first insert cap are spaced apart to extend forward of said first connector face in a keyed arrangement for reciprocally engaging a second housing having a second insert cap with two second tangs, said two first tangs fitting adjacent to the second insert cap, said first insert cap fitting adjacent to the second insert cap and the second tangs, and said first connector face fitting against a second forward surface of the second insert cap;

said first insert cap having two interior passages which define first plug body cavities within which are disposed respective ones of a first pair of said termini; and

said first connector face having a pair of interior passages which define two first connector cavities which are disposed between said first insert cap and said two first tangs, from which respective ones of a second pair of said termini extend.

2. The multi-channel fiber optic cable connector of Claim 1, wherein said two insert cap cavities are aligned with two second connector face cavities of the second connector face for receiving respective ones of a third pair of two of said termini therebetween, and said connector face cavities are aligned with two second insert cap cavities of the second insert cap cavities for receiving a fourth respective pair of said termini therebetween.

3. The multi-channel fiber optic cable connector of Claim 2, wherein said first insert cap, said first connector face and said two first tangs are identically arranged to the

second insert cap, the second connector face and the second tangs to provide a hermaphroditic fiber optic cable connector.

4. The multi-channel fiber optic cable connector of Claim 3, further comprising

said first housing have two spaced apart sets of exterior screw threads;

a first coupling sleeve extending around said first housing, said first

5 coupling sleeve having at least one set of interior screw threads for threadingly securing said first coupling sleeve to said first housing in first and second positions;

wherein when disposed in said first position, said first coupling sleeve is secured to said first housing in rearward position relative to said first housing to dispose said first connector in a male mode; and

10 wherein when disposed in said second position, said first coupling sleeve is secured to said first housing in a forward position relative to said first housing to dispose said first connector in a female mode, such that when in the forward position said first coupling sleeve is rotatable relative to said first housing for threadingly engaging the second housing to secure said first housing to the second housing with mating termini impinging
15 onto another on end mating surfaces and aligned for transmitting light signals therebetween.

5. The multi-channel fiber optic cable connector of Claim 4, further comprising a pin which extends from said first coupling sleeve into said first housing to non-rotatably secure said first coupling sleeve to said first housing in said first position, wherein said connector is disposed in said male mode.

6. The multi-channel fiber optic cable connector of Claim 1, further comprising

said first housing have two spaced apart sets of exterior screw threads;

5 a first coupling sleeve extending around said first housing, said first coupling sleeve having at least one set of interior screw threads for threadingly securing said first coupling sleeve to said first housing in first and second positions;

wherein when disposed in said first position, said first coupling sleeve is secured to said first housing in rearward position relative to said first housing to dispose said first connector in a male mode; and

10 wherein when disposed in said second position, said first coupling sleeve is secured to said first housing in a forward position relative to said first housing to dispose said connector in a female mode, such that said first coupling sleeve is rotatable relative to said first housing for threadingly engaging the second housing to secure said first housing to the second housing with mating termini aligned for transmitting light signals therebetween.

7. A multi-channel fiber optic cable connector for connecting the terminal ends of two multi-channel fiber optic cables having termini of respective ones of multiple optical fibers included within said cables, the connector comprising:

a housing having an insert body with a plurality of interior passages disposed therein for receiving respective ones of the termini of the optical fibers of one of said cables;

at least one mating plane for aligning with a second at least one mating plane of a second housing for transmitting light signals therebetween;

a plurality of shoulders disposed to extend substantially transverse to the longitudinal axes of said passages for retaining said termini within said passages;

a plurality of inwardly extending protuberances which extend inwardly within respective ones of said interior passages, each of said interior passages having one of said shoulders and one of said protuberances, and wherein said shoulders are spaced apart from respective ones of said protuberances and said mating plane, and said protuberances are distally disposed from said mating plane;

said protuberances fitting around respective ones of said termini, to gimbal said termini within respective ones of said interior passages, wherein said terminal ends of said termini may angularly move transverse to respective ones of said longitudinal axes thereof, pivoting about said protuberances;

a plurality of floating collars, each of which extends around a respective one of said termini with a clearance fit between said respective ones of said floating collars and said termini such that said floating collars are free to move parallel to longitudinal axes of said respective termini;

first seal elements disposed within respective ones of first seal glands, and sealingly engaging between said respective termini and said floating collars;

said floating collars having seal faces which extend parallel to said longitudinal axes of said respective termini, spaced apart from respective ones of said interior passages of said housing to define second seal glands therebetween;

second seal elements disposed in said second seal glands, extending around respective ones of said longitudinal axes of said respective termini, and sealingly engaging between respective ones of said seal faces and said interior passages when said termini are angularly displaced about said protuberances;

biasing means to energize said second seal elements;

continuous ceramic sleeves having interior bores which are of a slightly wider cross-section than said termini, providing clearance fits between said continuous ceramic sleeves and said termini over lengths which extend parallel to respective ones of said longitudinal axes of said termini; and

wherein mating ones of said termini fit within opposite ends of respective ones of said continuous ceramic sleeves to align said terminal ends of said mating ones of said termini for transmitting light signals therebetween.

8. The multi-channel fiber optic cable connector of Claim 7, wherein said two insert cap cavities are aligned with two second connector face cavities of said second connector for receiving two of said termini therebetween, and said connector face cavities are aligned with two second insert cap cavities of said second insert cap cavities for receiving a second respective two of said termini therebetween.

9. The multi-channel fiber optic cable connector of Claim 8, wherein said insert cap, said connector face and said tangs are identically arranged to said second insert cap, said second connector face and said second tangs to provide a hermaphroditic fiber optic cable connector.

10. The multi-channel fiber optic cable connector of Claim 9, further comprising

said housing have two spaced apart sets of exterior screw threads;

5 a coupling sleeve extending around said housing, said coupling sleeve having at least one set of interior screw threads for threadingly securing said coupling sleeve to said housing in first and second positions;

wherein when disposed in said first position, said coupling sleeve is secured to said housing in rearward position relative to said housing to dispose said connector in a male mode; and

10 wherein when disposed in said second position, said coupling sleeve is secured to said housing in a forward position relative to said housing to dispose said connector in a female mode, such that said coupling sleeve is rotatable relative to said housing for threadingly engaging the second housing to secure said housing to said second housing with mating termini aligned for transmitting light signals therebetween.

11. The multi-channel fiber optic cable connector of Claim 10, further comprising a pin which extends from said coupling sleeve into said housing to non-rotatably secure said coupling sleeve to said housing in said first position, wherein said connector is secured in said male mode.

12. The multi-channel fiber optic cable connector of Claim 8, wherein said plug body, said connector face and said tangs are identically arranged to said second plug body, said second connector face and said second tangs to provide a hermaphroditic fiber optic cable connector.

13. The multi-channel fiber optic cable connector of Claim 7, further comprising

said housing have two spaced apart sets of exterior screw threads;
a coupling sleeve extending around said housing, said coupling sleeve
5 having at least one set of interior screw threads for threadingly securing said coupling
sleeve to said housing in first and second positions;

wherein when disposed in said first position, said coupling sleeve is
secured to said housing in rearward position relative to said housing to dispose said
connector in a male mode; and

10 wherein when disposed in said second position, said coupling sleeve is
secured to said housing in a forward position relative to said housing to dispose said
connector in a female mode, such that said coupling sleeve is rotatable relative to said
housing for threadingly engaging the second housing to secure said housing to said second
housing with mating termini aligned for transmitting light signals therebetween.

14. The multi-channel fiber optic cable connector of Claim 13, further
comprising a pin which extends from said coupling sleeve into said housing to non-
rotatably secure said coupling sleeve to said housing in said first position, wherein said
connector is secured in said male mode.

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15. A multi-channel fiber optic cable connector for connecting the terminal ends of two multi-channel fiber optic cables having termini of respective ones of multiple optical fibers included within said cables, the connector comprising:

a housing having an insert body with a plurality of interior passages disposed therein for receiving respective ones of the termini of optical fibers of one of said cables, at least one mating plane for aligning with a second and at least one mating plane of a second housing for transmitting light signals therebetween, and a plurality of shoulders disposed to extend substantially transverse to the longitudinal axes of said passages, and a plurality of inwardly extending protuberances which extend inwardly within respective ones of said interior passages, each of said interior passages having one of said shoulders and one of said passages, and wherein said shoulders are spaced apart from respective ones of said protuberances and said mating plane, and said protuberances are distally disposed from said mating plane;

said protuberances fitting around respective ones of said termini, to gimbal said termini within respective ones of said interior passages, wherein said terminal ends of said termini may angularly misalign to respective ones of said longitudinal axes thereof, pivoting about said protuberances;

a plurality of floating collars, each of which extends around a respective one of said termini with a clearance fit between said respective ones of said floating collars and said termini such that said floating collars are free to move parallel to longitudinal axes of said respective termini;

first seal elements disposed within respective ones of first seal glands, and sealingly engaging between said respective termini and said floating collars;

said floating collars having seal faces which extend parallel to said longitudinal axes of said respective termini, spaced apart from respective ones of said interior passages of said housing to define second seal glands therebetween;

second seal elements disposed in said second seal glands, extending around respective ones of said longitudinal axes of said respective termini, and sealingly engaging between respective ones of said seal faces and said interior passages when said
 30 termini are angularly displaced about said protuberances;

biasing means to energize the second seal elements;

continuous ceramic sleeves having interior bores which are of a slightly wider cross-section than said termini, providing clearance fits between said continuous ceramic sleeves and said termini over lengths which extend parallel to respective ones of
 35 said longitudinal axes of said termini;

wherein mating ones of said termini fit within opposite ends of respective ones of said continuous ceramic sleeves to align said terminal ends of said mating ones of said termini for transmitting light signals therebetween;

said housing having a forwardly extending insert cap, a connector face and
 40 two forwardly extending tangs, said insert cap extending forward of said connector face, and wherein said two tangs and said insert cap are spaced apart in a keyed arrangement for receiving a second main body having a second insert cap and two second tangs, said tangs fitting adjacent to the second insert cap, said insert cap fitting adjacent to the second insert cap and the second tangs and said connector face fitting against a forward face of
 45 the second insert cap;

said insert cap having two of said interior passages of said housing which define insert cap cavities within which are disposed respective ones of said termini; and

said connector face having a second two of said interior passages of said housing which define two connector face cavities which are disposed between said insert
 50 cap and said tangs, from which respective ones of said termini extend.

16. The multi-channel fiber optic cable connector of Claim 15, wherein said two insert cap cavities are aligned with two second connector face cavities of said second

connector face of said second connector for receiving two of said termini therebetween, and said connector face cavities are aligned with two second plug body cavities of said second insert cap cavities for receiving a second respective two of said termini therebetween.

17. The multi-channel fiber optic cable connector of Claim 15, wherein said insert cap, said connector face and said tangs are identically arranged to said second insert cap, said second connector and said second tangs to provide a hermaphroditic fiber optic cable connector.

18. The multi-channel fiber optic cable connector of Claim 15, further comprising

said housing have two spaced apart sets of exterior screw threads;

a coupling sleeve extending around said housing, said coupling sleeve having at least one set of interior screw threads for threadingly securing said coupling sleeve to said housing in first and second positions;

wherein when disposed in said first position, said coupling sleeve is secured to said housing in rearward position relative to said housing to dispose said connector in a male mode; and

wherein when disposed in said second position, said coupling sleeve is secured to said housing in a forward position relative to said housing to dispose said connector in a female mode, such that said coupling sleeve is rotatable relative to said housing for threadingly engaging the second housing to secure said housing to said second housing with mating termini aligned for transmitting light signals therebetween.

19. The multi-channel fiber optic cable connector of Claim 18, further comprising a pin which extends from said coupling sleeve into said housing to non-

rotatably secure said coupling sleeve to said housing in said first position, wherein said connector is secured in said male mode.

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20. A method for joining two multi-channel fiber optic cables for transmitting light signals therebetween, comprising the steps of:

providing first and second connector housings, each having a plurality of interior passages for receiving respective ones of termini of the optical fiber of the fiber optic cables, with the interior passages of respective ones of the first and second connector housings aligned for registering with respective ones of the interior passages of the other of the first and second connector housings;

mounting a plurality of floating collars around the termini, each of the floating collars mounted to a respective one of the termini, slidable in a longitudinal direction relative to the respective termini;

disposing first seal elements between the floating collars and the respective ones of the termini, sealingly engaging therebetween;

disposing second seal elements between the floating collars and the interior passage of respective ones of the first and second connector housings;

biasing the floating collars into forward positions, wherein the forward ends of the floating collars are pressed against the first seal elements to energize the first seal elements to sealingly engage between the floating collars and the interior surfaces of respective ones of the first and second connector housings;

mounting the termini within respective ones of the interior passages of the first and second connector housings, with the termini angularly moveable with respect to a gimbal point which is distally disposed from terminal ends of the respective ones of the termini, and the second seal element sealingly engaging between the floating collars and the interior passages of the housing as the termini are angularly moved within the respective ones of the interior passages;

slidably disposing respective ones of continuous rigid sleeves within respective ones of the interior passages of the first and second connector housings, with

respective ones of the termini disposed in each of the continuous rigid sleeves with a slidably engaging clearing therebetween; and

30 mating the first connector housing with the second connector housing to slidably engage the termini of respective ones of the first and second connector housings within corresponding ones of the continuous sleeves to align the termini of the first and second connectors for transmitting light therebetween.

21. The method of Claim 20, further comprising:

5 providing each of the first and second connector housings with respective ones of two coupling sleeves which extend around respective ones of the first and second connector housings and are threadingly securable thereto in at least first and second positions;

10 threadingly securing a first one of the two coupling sleeves to the first connector housing in the first position, wherein the first one of the two coupling sleeves is disposed rearward of a forward end of the first connector housing to dispose the first connector housing and the first one of the two coupling sleeves in a male mode; and then, threadingly securing a second one of the two coupling sleeves to the second connector housing in the second position, wherein the second one of the two coupling sleeves is disposed forward relative to the first position, to dispose the second connector housing and the second one of the two coupling sleeves in a female mode.

22. The method of Claim 21, further comprising the step of latching the first one of the two coupling sleeves into the first position relative to the forward end of the first connector housing, to latch the first connector housing and the first one of the two coupling sleeves into the male mode.